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► **To cite this version:**

E. Gravier, T. Drouot, M. Lesur, A. Guillevic, G. Lo-Cascio, et al.. Collision rates estimated from exact N-body simulations. 49th European Plasma Physics Conference (EPS 2023), EPS, Jul 2023, Bordeaux, France. <hal-04250462>

**HAL Id: hal-04250462**

**<https://hal.science/hal-04250462v1>**

Submitted on 19 Oct 2023

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## Collision rates estimated from exact $N$ -body simulations

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In a plasma, the charged particles interact via long-range forces and this interaction causes the plasma to exhibit collective effects. If the graininess or coupling parameter  $g$  goes to zero (ideal collisionless plasma), two-body collisions are negligible while collective effects dominate the dynamics. In contrast, when  $g \sim 1$  collisions play a significant role. To study the transition between a collisionless and a collisional regime, a  $N$ -body code was developed and used in this work. The code solves exactly, in one spatial dimension, the dynamics of  $N$  infinite parallel plane sheets for both ion and electron populations [1-3]. We illustrate the transition between individual and collective effects by studying two basic plasma phenomena, the two-stream instability and Langmuir waves, for different values of  $g$ . The numerical collision rates given by the  $N$ -body code increase linearly with  $g$  for both phenomena, although with proportionality factors that differ by roughly a factor of two, a discrepancy that may be accounted for by the different initial conditions. All in all, the usual collision rates published in the literature (Spitzer collisionality [4]) appear to compare rather well with the rates observed in our simulations [5].

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